TITLE: TESTING OF PROTOTYPE CWF BURNERS AT CHATHAM, N.B.

FINAL REPORT

BY

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Work was conducted by Canada Center for Mineral and Energy Technology, Energy Mines and Resources Canada.

DSS FILE NO. 15SQ.23440-4-9149
DSS CONTRACT SERIAL NO. OSQ84-00219
CANMENT PROJECT NO.
CANMET SCIENTIFIC AUTHORITY: DR. H. WHALEY

DATE: FEBRUARY 26, 1985

A Joint Project By:

The New Brunswick Electric Power Commission

Energy Mines and Resouces Canada

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TESTING OF PROTOTYPE CWF BURNERS

AT CHATHAM, N.B.

1.0 INTRODUCTION

The Department of Energy Mines and Resources has identified coal water fuels technology development as a priority.

Funding has been provided under special Atlantic Initiatives. Currently funding is supporting a CWF fuel preparation facility located in Sydney, N.S. and CWF firing demonstrations at N.B. Power's Chatham Generating Station.

In its role of technology support to this initiative, the Canadian Center for Minerals and Energy Technology (CANMET) has been involved in the development of CWF burners through the Chatham Utility Boiler Demonstration Project and also of second generation burners through R & D support.

The purpose of this program was to test prototype burners. The principle burners tested were the NRC burner and Lezzon burner. Only the results of the tests on these burners are identified within this report.

2.0 EXECUTIVE SUMMARY

On October 16 & 17, 1984 two NRC burners were tested at the Chatham Generating Station.

The purpose of this burner demonstration was to verify the scale up criteria used in scaling the NRC burner gun to 40 million BTU's per hour. Of the two burner assemblies that were tested, each contained wear resistant ceramic parts.

The burners were demonstrated as being able to use steam as an atomizing medium as well as being capable of changing from CWF fuel to heavy oil fuel and back without removing the nozzle gun assembly.

The ability to adjust the conical tip and orifice plate aperature without removing the gun is considered to be a major advantage of this burner gun.

In general, the NRC nozzle gun from the thermal plant operations staff's view shows excellent promise.

On December 17, 1984 a demonstration test was performed on the Lezzon burner gun which was provided on rental from the Center of Energy Studies of Nova Scotia.

After several tries with ignition of coal water fuel in the Lezzon gun, the test was aborted. At no time could a good quality fire be obtained with ignitors in position.

The general conclusion is that the Lezzon gun requires substantial engineering design work to eliminate differential expansion and the effect of heat from adjacent burners when inserted into a multi-burner furnace.

SOMMAIRE

Les 16 et 17 octobre 1984, deux brûleurs NRC ont été mis à l'essai à la centrale de Chatham.

Le but de cette démonstration de brûleurs était de vérifier les critères d'accroissement de capacité utilisés pour extrapoler la capacité d'un brûleur NRC jusqu'à 40 million BTU par heure. Chacun des deux assemblages de brûleur mis à l'essai comportait des pièces en céramique résistante à l'usure.

Les brûleurs se sont avérés capables d'utiliser la vapeur comme agent d'atomisation ainsi que de fonctionner alternativement avec le combustible charbon-eau ou le mazout lourd sans qu'il soit nécessaire d'enlever l'assemblage de brûleur.

La capacité d'ajuster le bec cônique et l'ouverture du brûleur sans enlever l'assemblage est jugée être un avantage important de ce brûleur.

En général, de l'avis du personnel d'exploitation de la centrale thermique, brûleur NRC est très prometteur.

Le 17 décembre 1984 s'est effectué un essai d'utilisation du brûleur Lezzon fourni sous location par le Center of Energy Studies de la Nouvelle-Écosse.

Après plusieurs essais d'allumage du combustible eau-charbon dans le brûleur Lezzon, les essais ont été abandonnés. Il n'a jamais été possible d'obtenir une flamme de bonne qualité même avec les allumeurs en place.

La conclusion d'ensemble est que l'aspect technique de la conception du brûleur Lezzon doit faire l'objet d'un mise au point considérable pour éliminer les problèmes d'expansion thermique résultant de la chaleur des brûleurs avoisinants.

3.0 INTERNATIONAL MEETING

Representatives from United States, Sweden, Holland, Spain, Japan and Canada of the International Energy Agency, Annex II Executive held their meeting in Fredericton, October 12, 1983.

The following day they were transported to the Chatham Generating Station to witness the operation of the Chatham Unit #1 boiler firing coal water fuel prepared by CBDC's coal water fuel preparation facility in Sydney, N.S. This operation was carried out using the Forney burner.

A listing of those representatives are as follows:

D.M. Rankin - N.B. Power
Cas Foster - U.S. Dept. of Energy
Horace Whaley - EMR Canada - CANMET
J. Bino Fortiun - Netherlands (NEOM)
Jose Gimenez - Spain (UNESA)
Mrs. Jose Giminez - Spain
Per J. Sveningsson - Sweden (Beijer Institute)
Ms. Brigitta - Palmberger Sweden
Hisashi Sukesada - Japan (New Energy Development Organization - Tokyo)
Makoto Kawaguchi - Japan (New Energy Development Organization - Tokyo)
Donald MacDonald - Chatham Plant Superintendent
Cliff Adams - EMR
Dr. H. Feibus - U.S. Dept. of Energy

4.0 N.R.C. BURNER TEST

The purpose of this burner demonstration was to verify the scale up criteria used in scaling the NRC burner nozzle gun to 40×10^6 BTUs per hour.

Two burning assemblies were supplied, each containing wear resistant ceramic parts.

Actual testing was conducted on October 16th & 17th/84 using Chatham Unit No. 1 boiler.

The results of the two day test were as follows:

1) Preheating of the coal water fuel improved the intensity of the flame.

2) The burner was demonstrated as being able to use steam as an atomizing media.

3) The burner gun was demonstrated as being capable of changing from CWF fuel to heavy oil fuel and back without removing the nozzle gun assembly.

4) The nozzle gun was able to burn heavy fuel oil cleanly and efficiently.

5) The ability to adjust the conical tip and switch from CWF to heavy fuel oil without removing the gun is considered to be a major advantage of this burner gun.

6) A thermal couple was attached to the gun which allowed the operators to have a temperature indication of the fuel at the nozzle when operating.

7) In general the NRC nozzle gun from a thermal plant operator point of view shows excellent promise.

Further details are available in Appendix 2 of this report.

5.0 LEZZON BURNER DEMONSTRATION

A contract (Purchase Order No.: 060-1888) was awarded to the Center of Energy Studies of Nova Scotia for the rental and supply of a lezzon burner gun suitable for use in the Chatham No. 1 boiler plus sufficient auxiliaries over and above that at the Chatham Plant for operation of this burner gun.

Through a series of delays the burner gun was not available for demonstration the week of October 15 as originally scheduled. This gun became available in early December 1984. However, because of tube leaks in the boiler in Chatham, the test was unable to be conducted until December 17, 1984. At that time the test was carried out with considerable difficulty.

With adjacent burners in operation when the lezzon burner gun was inserted the gun seemed to expand thus causing changes to the settings and clearances for the gun resulting in poor atomization. After several tries with ignition of coal water fuel in the lezzon gun the test was aborted. At no time could a good quality fire be obtained with igniters in position.

The general conclusion is that this burner needs substantial Engineering Design work to eliminate differential expansion and the effect of heat from adjacent burners when inserted into a multi-burner furnace.

A detailed report on this test is to be found in Appendix I of this report.

6.0 COSTS SUMMARY

N.B. Power was awarded a contract by the Department of Energy, Mines and Resources CANMET, Energy Research Laboratories for the purposes of testing prototype burners for a sum not exceeding 49,867.26.

As of January 31, 1985, N.B. Power has recorded the following charges:

N.B. Power Recorded Labour & Expenses	29,393.59
CES Contract (P.O. No. 060-1888)	19,867.26
Energy Credit	2,826.45 CR
TOTAL	$ 46,434.40

For a detailed account of cost refer to Appendix 3.

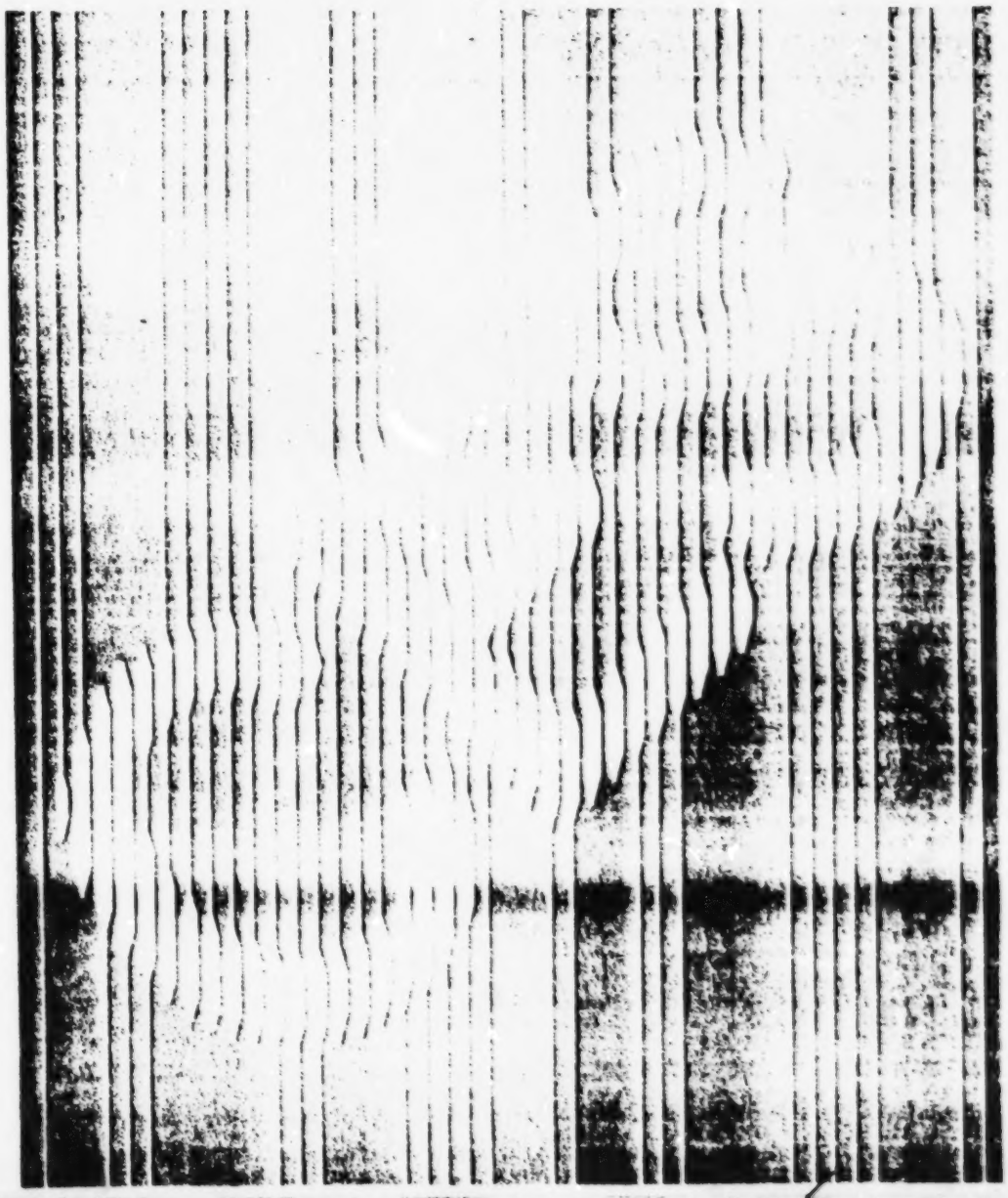
APPENDIX 1

- Testing of a 10 Gallon/Minutes Lezzon nozzle in The New Brunswick Electric Power Commission's Boiler Test Facility.

- Mr. K. Keoughan's Handwritten Diary Notes of Lezzon Gun Test Dated December 17, 1984.

Centre for
Energy Studies

TESTING OF A 10 GALLON/MINUTE LEZZON NOZZLE IN THE NEW BRUNSWICK ELECTRIC POWER COMMISSION'S BOILER TEST FACILITY



TESTING OF A 10 GALLON/MINUTE LEZZON NOZZLE IN THE NEW BRUNSWICK ELECTRIC POWER COMMISSION'S BOILER TEST FACILITY

LEZZON CHATHAM REPORT

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1.0 Introduction

2.0 Experimental Setup

3.0 Water Spray Tests

4.0 CWM Burn In #1 Boiler, Chatham

5.0 Observations

1.0 INTRODUCTION

The Department of Energy Mines & Resources - Canada has funded a comprehensive Research and Development program as part of the special "Atlantic Iniatives Coal Utilization Program". This R & D work includes fuel preparation and burner development for Utility Boilers. The burner development work is underway at several sites, principally at the New Brunswick Power Commission Chatham Generating Station and involves testing of several nozzles and burner systems. Two small utility boilers are the host sites for combustion testing to determine: fuel atomization; carbon burnout; flame characterization; nozzle erosion; and other parameters of several specific nozzles and burner systems using oil and coal water slurry fuel.

The two boilers at Chatham allow testing of front wall and tangental firing of the candidate nozzle systems. The front wall unit at Chatham is a Foster Wheeler balanced draft boiler designed for 12.5 MW(e) using New Brunswick coal. Tests of new burner systems developed by Foster Wheeher have been reported by Whaley et. al.(1)

Tests of two additional recent competitor nozzle systems were requested by NBPC on behalf of EM&R; one developed by the National Research Council of Canada, Chemical Engineering Division, and one by the Lezzon Group of Manchester New Hampshire.

The Lezzon Group had conducted preliminary testing of a nozzle capable of 1.8 MW(t) in the combustion test facility at the Centre for Energy Studies,

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(1)Whaley, H., Ranken, D.M., Landry, P.G., and Carle, I.D., "Utility Boiler Demonstration of Coal Water Mixture Combustion at Chatham New Brunswick". 6th International Symposium on Coal Slurry Combustion and Technology, Orlando Fla., U.S.A. June 25-27, 1984.

Technical University of Nova Soctia. On the basis of the results of these tests additional funds were committed by EM&R through the Oil Substitution Agreement between EM&R Canada and the Nova Scotia Department of Mines & Energy for a more complete test and evaluation of the Lezzon Nozzle. This testing program is being completed. The objective of the program was to identify in a small scale test (1.8 MW_t) the characteristics of the Lezzon nozzle and to identify necessary modifications. The program originally proposed by the Lezzon Group was comprehensive and phased to allow logical development. At the time of presentation of the proposal, the Lezzon Group were requested to attempt to scale up a nozzle for testing at Chatham (40 MT_t). It was pointed out to the scientists at EM&R that this was out of sequence to an orderly development plan and offered potential for misadventure. The Lezzon Group were assured that these concerns were understood and that the results of tests at Chatham would be viewed as a necessary part of the nozzle development.

As a result, funds were put in place through the New Brunswick Power Commission cooperative agreement with EM&R Canada and a contract placed with the CES/TUNS (with subcontract to the Lezzon Group) to design build and conduct preliminary testing with Carbogel fuel at Chatham. Subsequently, delays in manufacture of the nozzle components delayed the testing until early December 1984.

As a part of nozzle development, researchers have identified atomization of the C-W fuel as the principal requirement to minimize unburned carbon loss. Agglomeration of CW droplets has been identified as a major impediment to increased use of these new fuels.

Desirable burner nozzle characteristics for coal liquid mixtures have

been suggested from recent CLM workshops. They are listed as follows:

i) reduced mean droplet size;

ii) increased carbon conversion efficiency;

iii) reduced energy losses due to high atomization air and fuel pressures; and

iv) increased burner tip life.

The Lezzon nozzle has been put forward as a candidate meeting the above criteria. In this nozzle, the atomizing fluid and fuel to be sprayed are formed into adjacent sheets. The control of the thicknesses of the sheets, independent of pressure, results in independent control of droplet size, flow rates, and spray dilution. This nozzle, termed the variable gas atomization nozzle, is claimed to have improved burner tip life and operating characteristics as a result of the atomization and spray mechanism, and the control provided.

2.0 TEST SET UP

A demonstration test of the nozzle at the boiler test facility of the New Brunswick Electric Power Commission at Chatham, N.B. was conducted December 17, 1984. Equipment had been transpsorted to and set up at Chatham December 2 but no test was performed because of leaks in the stream drum header. The test team visited Chatham December 9th again but testing was aborted because electrical lock out occured in the boiler test facility.

For the test program, a modular system, including the fuel pump, piping and control equipment was designed and taken to Chatham. The included instrumentation allowed flow rates of the atomizing media and fuel to be accurately

measured to provide data to evaluate independent burner performance. A schematic diagram is presented in Figure 1, showing the storage and pumping system.

The atomizing media (air) flowrate measurement was made using a calibrated orifice and bypass rotameter. Compressed air supply was available at the site.

Pressure and temperatures of both fuel and air/steam, at the gun were measured. The gun and controls are shown schematically in Figure 2. This figure also shows the adjustable controls for the nozzle tip on the rear of the gun.

The fuel flowrate measurement was conducted by determining the change in height of the fuel in the day tank over a specific period (e.g. 10 min.).

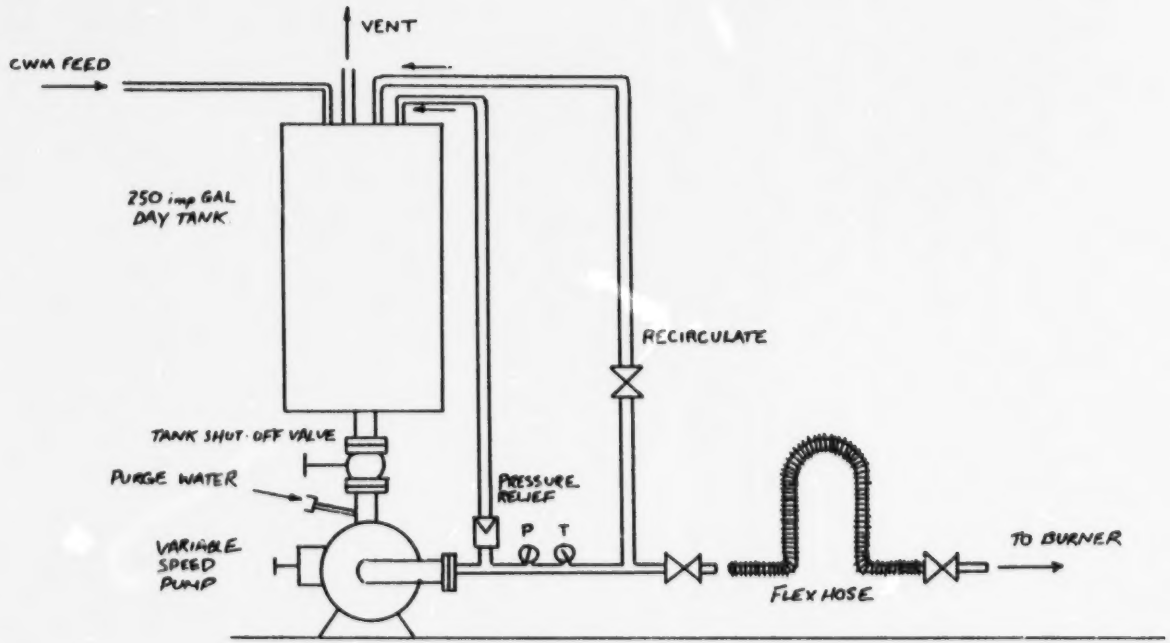
3.0 WATER SPRAY TESTS

Qualatative water spray tests were conducted at CES to observe the spray pattern from the Lezzon nozzle. The tests were made using the modular system to supply air and water.

Photographs are presented showing the spray and the modular system (Figures 3 and 4). The water spray 1/2 angle was measured as 22°. The water flowrate was determined to be 27.2 kg/min (60 lb/min) with an air flowrate of 9.2 m^3/min (325 ft^3/min). Both air and water pressures were less than 5 lb/in^2 at the gun.

4.0 DEMONSTRATION BURN

The demonstration burn was conducted on December 17, 1984 in Unit # 1 Chatham boiler (Foster Wheeler Unit). The gun was in position 4 with the modular system installed.



CES, CWM FUEL HANDLING SYSTEM

FIGURE 1

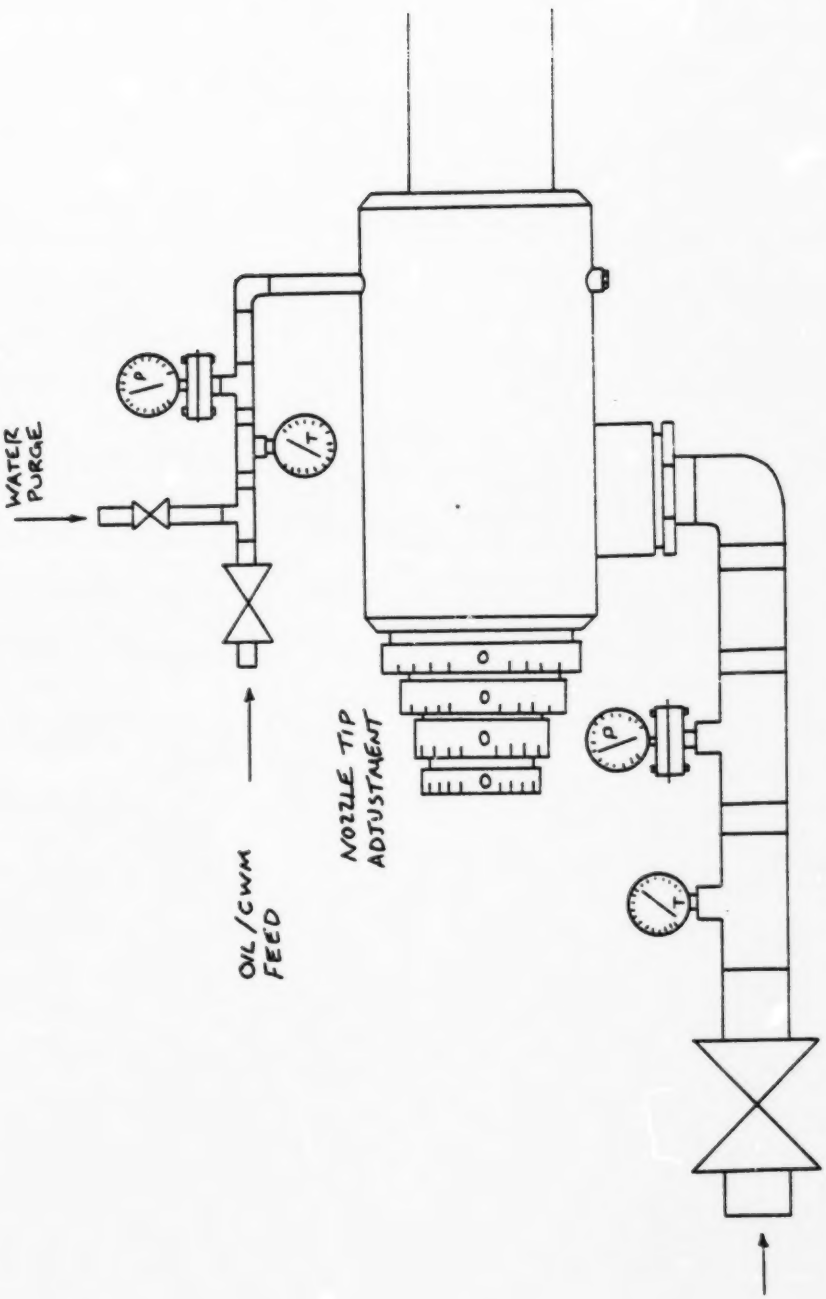


FIGURE 2 LEZZAN NOZZLE

Figure 3

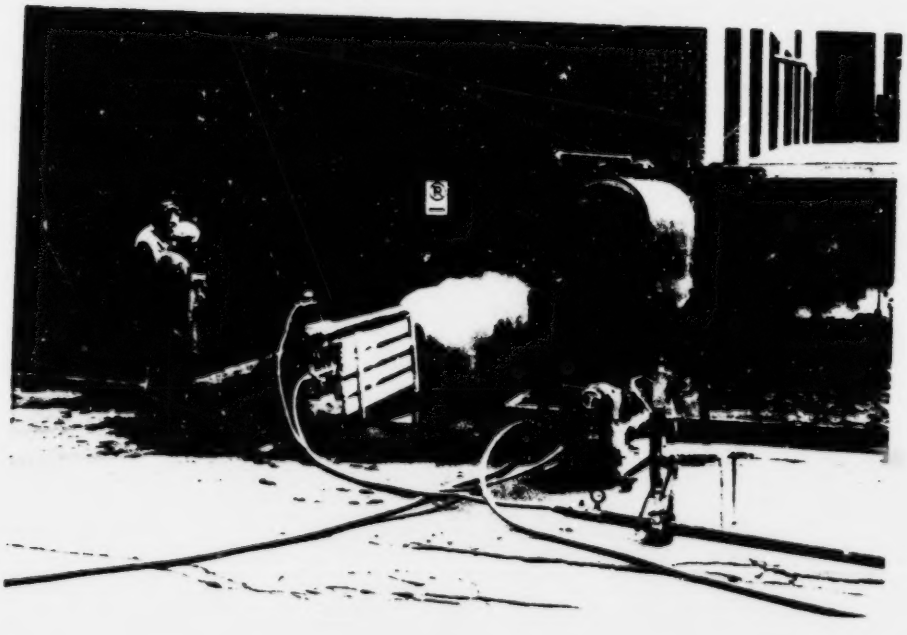


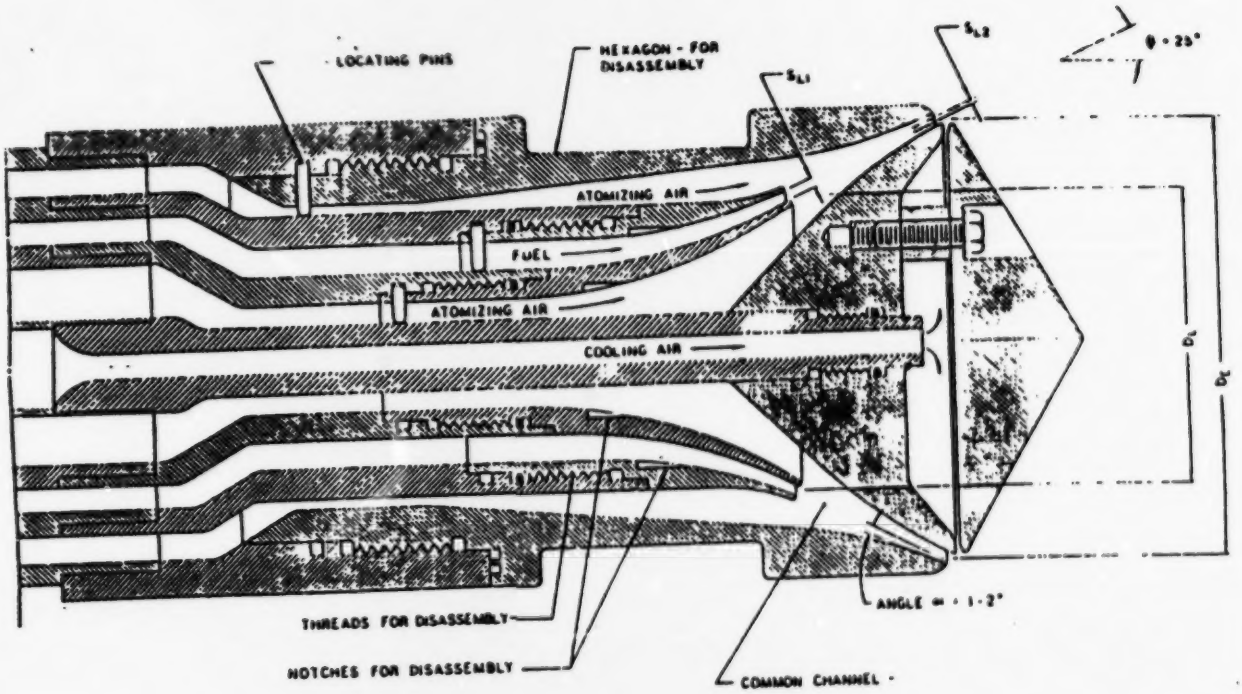
Figure 4

The gun and nozzle assembly are shown in Figure 5 and the photograph (Figure 6) was taken during maintenance, prior to testing, from inside the boiler. The ignitors are shown as well as the bluff body swirler. This swirler was removed before testing, because it would limit removal of the gun until maintenance could disconnect it from inside the boiler. The setup is shown schematically in Figure 7 locating the gun in the burner throat.

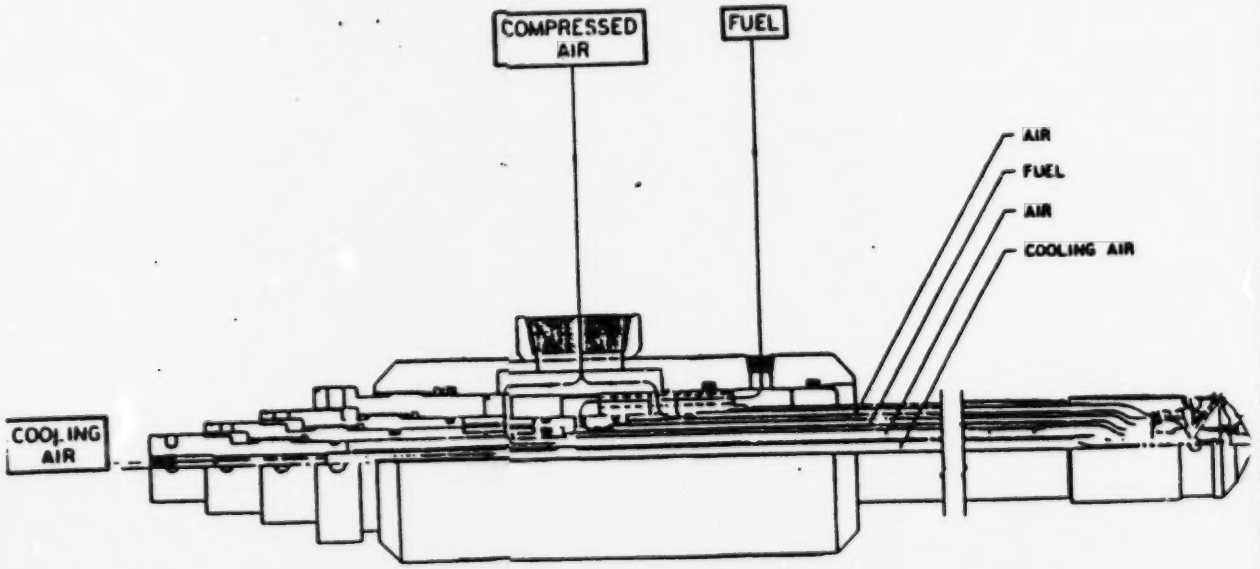
5.0 OBSERVATIONS

Two attempts to establish stable CW flames were made on December 17, 1984. Firstly, the gun was inserted and cooling air was fed to the central cooling air passage. When the atomization air was turned on the atomization air pressure was found to be higher than anticipated. Over a period of time the pressure increased. This was due to thermal expansion of the outer section of the nozzle tip. Adjustments were made to move the entire inner assembly of the nozzle forward to compensate for the closing of the final aperture. When the atomization air pressure was reduced to the anticipated level the first attempt at firing was made.

The shut off valve from the fuel handling system was opened and the fuel recirculation valve was closed. The line from the fuel delivery system was full of water, and this slug of water was pushed ahead of the fuel, fully wetting the inside of the nozzle. Observation from the rear of the boiler showed the initial water spray followed by the fuel sheet issuing from the nozzle tip. The fuel sheet did not atomize properly and large particles were seen in the furnace. The stack became dark with high unburned fuel particles. The fuel flowrate was also seen to be much lower than the FW gun in the adjacent burner throat. Some minor adjustments were attempted but no



ENLARGED VIEW OF TEST NOZZLE TIP



TYPICAL TEST NOZZLE
FIGURE V

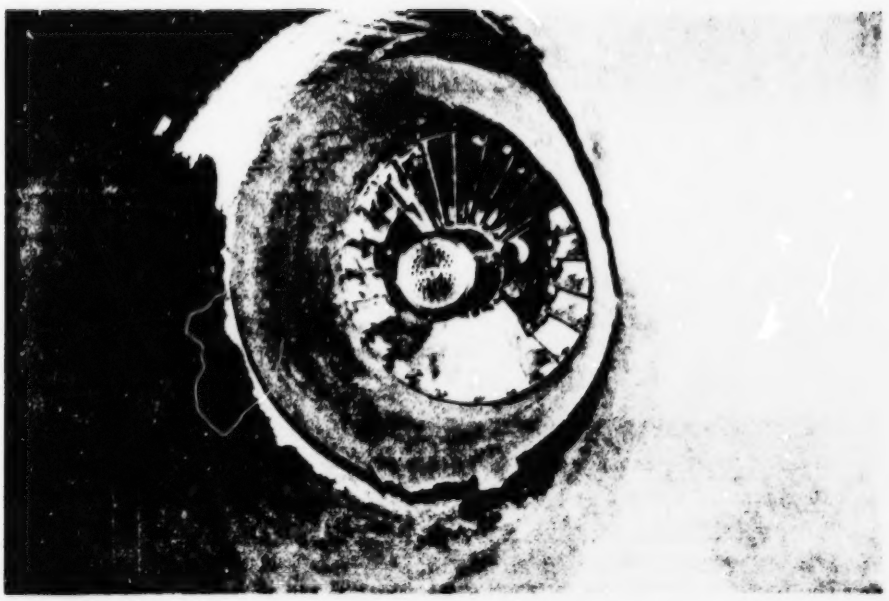
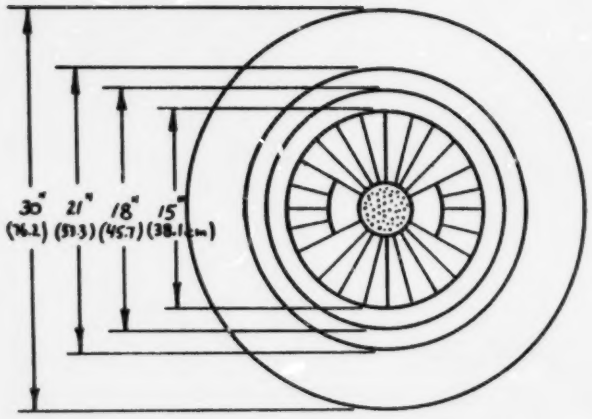


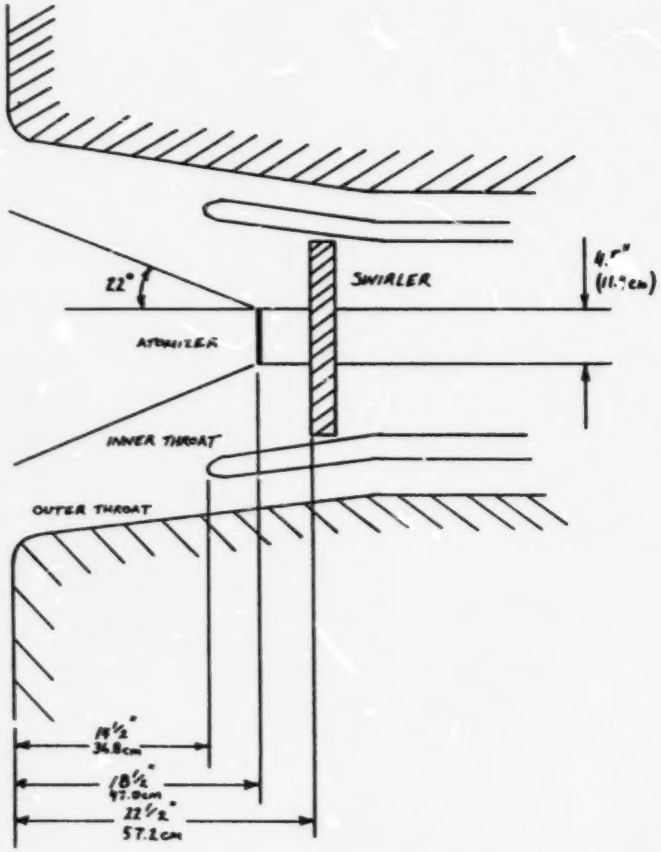
Figure 6

FIGURE 7

LEZZON NOZZLE

CHATHAM, N.B. INSTALLATION





improvement was seen. This short test was terminated because of the poor condition of the stack.

The gun was flushed through with water and retracted. Further adjustments were made. It was not possible to open the fuel gap beyond 0.0025 in whereas the design setting was 0.0037 in believed to be due to an error in the machining of the nozzle components.

The gun was reinserted with both cooling and atomization air turned on. A second attempt to fire CW was made. This time the fuel was atomized, but the fuel flowrate was much less than desired. Continual adjustment of the inner assembly to compensate for thermal expansion was made. The gun position was moved forward to improve the flame stability. Each time the gun was moved forward the outer tip was subjected to higher temperatures requiring further adjustment of the fired fuel sheet aperture. Although the igniter was on all the time, and the fuel flowrate was much lower than desired, considerable improvement in atomization and flame quality were observed.

A final movement forward of the gun proved fateful: the igniter flame impinged directly on the outer nozzle sleeve and caused the fuel aperture to close right off. This caused the fuel pressure to rapidly increase, since a progressive cavity pump was used for fuel supply, fuel was forced back down the air passages. The gun was immediately retracted and the test terminated.

The combination of the thermal expansion of the outer sheath; the machining error which prevented designed fuel flow; and the impingement of the igniter flame on the burner tip and resulting destruction of internal seals necessitated termination of further testing until these problems could be overcome.

During testing at the Flame Tunnel Facility of CES/TUNS similar difficulties with expansion of the outer sheath of the burner gun were observed. Additional problems with flow separtation within the nozzle were observed and brought to the attention of the Lezzon Group. These difficulties will be corrected before completion of testing with coal slurries.

CONCLUSION

Testing of the 10 Igpm Lezzon Nozzle at the Chatham New Brunswick Combustion Test Facility was terminated due to:

(a) Differential elongation of component parts in the Nozzle

(b) Errors in machining which prevented the designed fuel flow rate to be achieved

(c) Destruction of the internal seals in the Nozzle due to inadvertant direct impingement of the ignitor flame on the Nozzle.

During the period when burning was underway (at the reduced flow rates) good atomization and flame quality were observed.

The difficulties experienced with the Nozzle have been reviewed with the Lezzon Group and it is believed that improvements can be made to correct the problems. Modifications to the Nozzle should be completed and a retest scheduled.

APPENDIX 1

THE LEZZON NOZZLE

DESIGN CHARACTERISTICS

The combustion nozzle designed for the test burn at Chatham, N.B., incorporated a number of features not included in the nozzle designed for the test program at TUNS.

1. In addition to being larger in size (4 3/8" tip diameter versus 1 7/8"), the tip concentricity was improved by incorporating needle bearing spacers to hold the accumulated tolerance of the exit annulus width to within ±.002". See Drawing B2111, B2112, B2113 and B2114.
2. To insure free rotation of the various concentric components, for tip adjustment purposes, the machined, mating surfaces at the end of feed tubes (Drawing B2107, B2108, B2109 and B2110) were held to tight tolerances relative to each other, and LT (light transition) fits with the adjoining parts were specified.
3. Cooling-air bleed holes were incorporated in the heat shield-deflector (Drawing B2170) to prevent build-up of unburned carbon.
4. The Chatham nozzle was fabricated at Colwell Industries, Dartmouth, N.S. A tip angle of 60° was selected, based upon the test results at TUNS using 50°, 60°, 70° and 80° tips. It should be noted that the original 50° tip angle had appeared satisfactory during the Phase I tests. Just prior to the start of the Phase II program, concern was expressed by the personnel at TUNS that a wider angle might be preferred, in order to match

the change of the tunnel refactory throat angle from 50° to 70°. As a result of this concern, tips of 60°, 70° and 80° were fabricated and tried during prelinimary tests at TUNS. The 60° tip was then selected for the Phase II TUNS program.

5. The outside diameter of the nozzle was specified so as to slip into the opening of the Chatham boiler after removal of the existing tubular sleeve that held the tip-located swirling vanes. The vanes were to be mounted directly onto the Lezzon nozzle. Removal of the tubular nozzle sleeve permitted the nozzle length to be approximately the same as that of the Foster-Wheeler nozzle, and the fuel and air feed entry connections to be located at about the same distance from the boiler face.

At the point in time when the nozzle fabrication had just been completed, TUNS personnel were informed by a visitor who had just completed testing at Chatham that the fabricated nozzle was too short. Both he and TUNS staff did not realize that the tubular sleeve mentioned in 5 above would be removed when the Lezzon nozzle would be tested. TUNS staff confirmed the measurements cited by their visitor with N.B. Electric Power Commission and being unable to contact the Lezzon Nozzle designer made the decision to lengthen the completed nozzle. This was done by cutting and adding an additional length. Later the Lezzon designer pointed out the method of operation as in 5 above did not result in the nozzle as manufactured being too short and his misgivings that the cut would affect the free rotation of the nozzle.

CHECK OUT & TEST

Upon assembly of the nozzle it was found that rotation of the outer two

tip feed components were indeed blocked as the result of a bow that has been introduced by the tube lengthening. The bow was found to be about 0.10 inches. The assemblies were set in a lathe and heated with a torch and bent until reasonable alignment was obtained. Upon subsequent assembly, free rotation was again established.

The nozzle was transferred to TUNS, reassembled with the O-Rings and adjusted to establish correct tip widths and corresponding angle positioning of the adjusting members (Drawing C2103, C2104 and C2105). Free rotation was confirmed, although some tightness was found, in turning part 2104. The nozzle was adjusted throughout its range, however, and calibration settings were established for the Chatham test. A water spray test was then performed at TUNS to check the nozzle integrity and the associated pump, meters and piping. Excellent atomization was obtained.

One additional nozzle fabrication error was discovered during the TUNS assembly on December 1, 1984. The flare contours of the inner gas tip (Drawing b2118) were found to deviate considerably from those specified on the drawing. Although this did not prevent the successful water spray test, the deviation was such that correct conical alignment of the fuel and air streams could not be achieved. It was felt by the writer that tip misalignment could interfere with proper atomization of fuels. The component was returned to the shop that afternoon and re-machined to the correct contour.

CHATHAM RESULTS

During subsequent test burn at Chatham, it was learned that when the nozzle became hot, after about 1 hour of operation, tip adjustment could not be made, because the nozzle components could not be rotated. The writer concluded from this that the nozzle tubes had apparently been excessively

stressed during the bending to correct the bow. Upon reheating the stresses had been relieved and the bowed condition had returned. At this point it was decided that the test should be postponed until the nozzle could be rebuilt with new feed tube components fabricated with correct tolerances.

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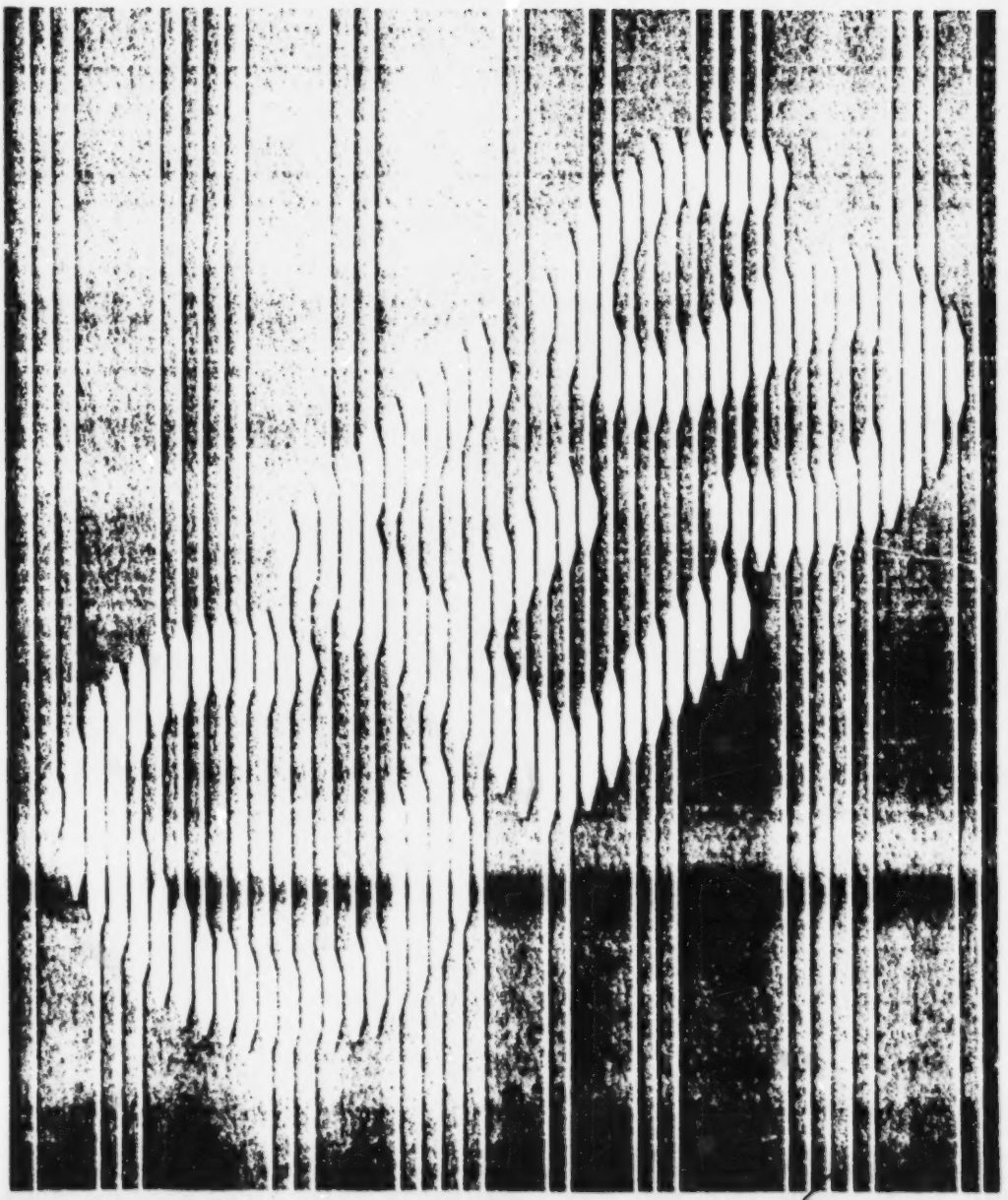

C.W.M. NOTES. K. KEOUGHAN DECEMBER 17, 1984

PAGE 1. LEZZON GUN TEST

WEATHER, OVERCAST, MILD, GUSTY WINDS

5:04 C.W. FUEL BURNER OUTAGE 19'7" 11,600 GAL 69.6 TONS START

WORK ORDERS ON NO 1 & 3 "WESI"S.

8:30 No 1 UNIT ON LINE ON BURNER "C" OIL - VACUUM ON UNIT PUR 2.3" Hg WITH QUICK START OIL

9:00 LEZZON GRAND MORNING CHANGES TO MATCH TOTAL AIR FLOW USED BY THOR GUN

GETTING READY TO PUT No 3 FARLEY GUN ON C.W. FUEL TO ASSESS FIRE

9:18 No 3 GUN LIT OFF ON C.W. FUEL WITH PILOT UNIT QUICK START OFF VACUUM TO 4" Hg. BACK ON C.W. PUMP DISCHARGE PRESS DROP - THOR SHOOT OR THOR'S MUST BE FOULING

9:20 PILOT STILL IN WITH No 3 C.W. FUEL GUN LOOKS OKAY WILL REMOVE PILOT WHEN NECESSARY IS NOT

9:25 PILOT REMOVED FROM No 3 C.W. FUEL GUN - FIRE GOOD BRIGHT CENTRE SLIGHTLY DARKER - GOOD STABLE SWIRL FIRE SMALL BUT C.W. FUEL PRESS AT 88 PSI AT AIR 116 PSIG DAMPER SETTINGS NORMAL WINDBOX PRESS 1.4" wg.

9:30 1 & 2 GUNS ON ALL 3 GUNS ON C.W. FUEL LOAD 2 MW - VACUUM 3" Hg.

SALT WATER STRAINERS CHANGED OVER - RAND 5.06 STRAINER NOW IN SERVICE.

10:00 C.W. FUEL STRAINERS BOTH CLEANED AT DISCHARGE OF MAIN PUMP

8:30 C.W. FUEL SAMPLE No 1 BURNER FRONT 560 cps @ 25°C DENSITY 116 MOISTURE 20.40%

NOTE: THE SWIRLER HAS BEEN REMOVED FROM No 4 BURNER SO THE LEZZON GUN CAN BE INSERTED & REMOVED FROM BURNER WHEN REQUIRED.

10:40 FILLING LEZZON FUEL TANK WITH WATER TO WET DOWN SYSTEM, LINES, & GUN.

11:00 No 4 C.W. FUEL LINE TO BURNER PURGED - TRYING TO CLEAR LINE TO FILL LEZZON C.W. FUEL TANK. BOTH FLUSHING WITH WATER TO ISOLATING VALVE & CHECK VALVE

C.W.M. NOTES — K. KOUGNIAN — DECEMBER 17, 1954
PAGE 2 — LEZZON GUN TEST

11:00 SCREENS WASHED VACUUM REMAINED THE SAME
11:30 VACUUM 7.7" Hg QUICK START OFF
11:45 GETTING SECOND C.W. FUEL GUN READY FOR SERVICE
VACUUM 4.6" Hg
12:00 VACUUM UP TO 5.9" Hg. QUICK START BACK ON.
12:30 C.W. FUEL BURNER OUTAGE 19" 11"
No 4 GUN C.W. FUEL SUPPLY LINE STILL PLUGGED + GOING TO USE HOSE FROM SAMPLE LINE TO FILL LEZZON FUEL TANK
13:15 FILLING LEZZON C.W. FUEL TANK
13:55 STACK EXCELLENT FOR 2 C.W. FUEL GUNS & 1 OIL GUN
LEZZON GETTING THEIR GUN READY TO FIRE
14:00 No 3 BURNER SLAGGING (UNBURNT FUEL) KNOCKED OFF
USING PRIMARY & SECONDARY DAMPERS
14:05 STARTED FILLING LEZZON FUEL TANK UP TO TOP.
LEZZON GUN BACKED OUT OF BOILER INSPECT METAL OF GUN WAS EXPANDED. CLEARANCE NOW NEED AS SET
NOTE: WILL NEED 200 COMPRESSOR WITH AIR REQUIREMENTS OF LEZZON GUN. ATOM. AIR ON 2 C.W. FUEL GUNS DROPS TO 50 AIR.
14:15 No 3 GUN SLAGGING AGAIN GETTING SPARE GUN READY WITH ANOTHER TIP. PUSH IN TO BURN UNBURNED FUEL OFF BURNER THROATS.
14:20 LEZZON GUN IN SERVICE. FUEL NOT ATOMIZING. BUILDING UP ON SCREEN WALL.
14:35 REMOVING LEZZON GUN FROM SERVICE STUCK GOT WORSE & HAVING UNBURNT FUEL BUILD-UP ON BURNER ASH RT AIR TUBES.
14:45 CACHING FUEL SIDE OF LEZZON GUN READY TO TRY GUN AGAIN FUEL BURNING THIS TIME WITH PILOT SEEMS TO BE SLAG (UNBURNT FUEL) FROM 1 TO 3 O'CLOCK. SWIRL IN SECONDARY THROAT NOT AS FULL AS 1 & 3 BURNERS FLAME BRIGHT & SMALL WITH PILOT.
15:05 LEZZON GUN No FUEL - ONLY PILOT VISIBLE
15:06 PURGING LEZZON GUN. C.W. FUEL BACK TO A. AIR SUPPLY HOSE WHEN HOSE DISCONNECTED.

A. KOOMENAN — DECEMBER 17, 1984

LEZZON GUN TEST

15:15 — THEY WILL CHECK GUN & SETTINGS ON LEZZON GUN TONIGHT & TRY & SET GUN UP TO ALLOW FOR THE EXPANSION WHEN GUN IS INSERTED IN FURNACE.

15:30 — GETTING 3RD CWL FUEL BUNK READY FOR SERVICE IN NO. 2 BURNER. NO 2 GUN ON CWL FUEL.

NOTE: CHANGING CONNECTIONS TO BURN OUT LEZZON FUEL TANK. FUEL TANK BURNED OUT

16:40 — NO 1 UNIT OFF LINE

17:30 — B. FRONT VISCOSITY 56 @ 24°C DENSITY 1.16 MOISTURE 30.83%

COMMENTS: WHEN LEZZON GUN WAS INSERTED INTO BURNER THE GUN EXPANDED THROWING OFF ALL SETTINGS. GUN WAS REMOVED FOR COOLING SETTINGS CHANGED AND TRIED AGAIN.

THE FIRST TIME GUN WAS TRIED THE ONLY FLAME VISIBLE WAS THE PILOT IN NO. 4 BURNER NO FLAME VISIBLE FROM MAIN LEZZON GUN.

FUEL BUILD UP ON BUR TUBES OF ASH PIT VISIBLE THROUGH SIDE. UNBURNED FUEL BUILD UP & BURNING IN THE ASH PIT.

FUEL OPENING WAS INCREASED ON LEZZON GUN & IT WAS TRIED THE SECOND TIME. THIS TIME FIRE FROM MAIN GUN WAS VISIBLE WITH PILOT. REASONABLE STABLE SWIRL BUT NOT FILLING THE SECONDARY THROAT AS GOOD AS FORMER GUNS. FLAME BRIGHT BUT QUITE SMALL. VERY DARK SECTION BETWEEN 1 & 3 O'CLOCK WHERE PILOT IS. GUN STILL EXPANDING & 15 MINUTES NEVER LIGHT OFF CUT FUEL SUPPLY OFF DUE TO EXPANSION

UNABLE TO STATE WEATHER FIRE WOULD HAVE BEEN GOOD OR POOR AS WE NEVER HAD A CHANCE TO REMOVE PILOT FROM SERVICE.

APPENDIX 2

- NRC's Report

  Demonstration of NRC Burning Assembly at Chatham Power Station, October 17-18, 1984.

- Mr. K. Keoughan's Notes on Tests.

National Research Council Canada
Conseil national de recherches Canada

Division of Chemistry
Division de chimie

Ottawa, Canada
K1A 0R6

Section Chemical Engineering

Date Jan. 7, 1985

REPORT · RAPPORT

For
Pour D. Rankin
New Brunswick Electric Power Commission

Subject
Sujet Demonstration of NRC Burning Assembly
at Chatham Power Station, Oct. 17-18, 1984.

Author A. Bennett
Auteur W.L. Thayer

Approved by
Approuvé par C. Edmund Capps
Section Head Chef de section

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Demonstration of the N.R.C. Atomizing Assemblies at the New Brunswick Electric Power Commission Utility Plant at Chatham Tuesday October 17th and Wednesday October 18th, 1984.

N.R.C. supplied two burning assemblies containing wear-resistant ceramic parts to be tested in the Foster Wheeler No. 1 boiler. Unfortunately both assemblies were too short. Although a stable flame was achieved, it was felt that the ideal nozzle/refactory position could not be achieved. Minimum impingement and atomization of the c.w. fuel in the hot air recirculating zone at the point of ignition could not be fully achieved using the gun available which had been constructed to measurements provided to NRC.

Tuesday Oct. 17th, 1984: Combustion was attempted with the NRC atomizing assembly which has the capability of being externally adjusted during firing. It was at this point discovered that the guns were too short. The balance of the day was then spent trying to compensate for this shortfall. At 2:12 P.M., a large, clean burning, c/w flame was achieved; the video shows a brief clip of this flame. Attention should be given to this flame because of the similarities to a heavy fuel oil flame unlike the normal c/w flame achieved in this boiler.

Wednesday Oct. 18th, 1984: The second N.R.C. atomizer was used. This model did not have the capability of external adjustment, but could be adjusted through the use of shims.

On the first ignition attempt it was felt that the flame was too long. The assembly was removed and the orifice size reduced. The flame was now of an acceptable size but could not be maintained without support. At this point a water test was undertaken, during which the optimum secondary/primary combustion air levels were visually achieved.

On switching back to c.w. fuel, a clean unsupported flame was maintained. N.B.E.P.C. measurements showed a rate of 6 U.S. gallons per minute at this condition. It was noted that the NRC atomizer produced a shorter and brighter flame than the Forney atomizer under similar conditions. The NRC nozzle was then readjusted to increase the firing rate. But impingement at this higher rate affected the stability of the flame.

At this point, a series of tests were performed to prove the versatility of the NRC atomizing assembly. They were:

a) Pre-heating of the c/w fuel - which improved the intensity of the flame, and enhanced the speed at which the excess moisture was driven off before ignition.

b) Using steam as the atomizing media.

c) On-line changeover from c.w. fuel to heavy fuel oil and back without removing the nozzle assembly.

d) The capability of being able to burn heavy fuel oil cleanly and efficiently with exactly the same nozzle as with c.w. fuels.

Although this work was of a very preliminary nature done under rushed non-ideal conditions (with no previous adjustment of the boiler conditions, nor experience with the NRC atomizer in this boiler), the excellent potential of the NRC atomizer was demonstrated and a longer term more formal test is amply justified.

A. Bennett

W.L. Thayer

January 7, 1985.

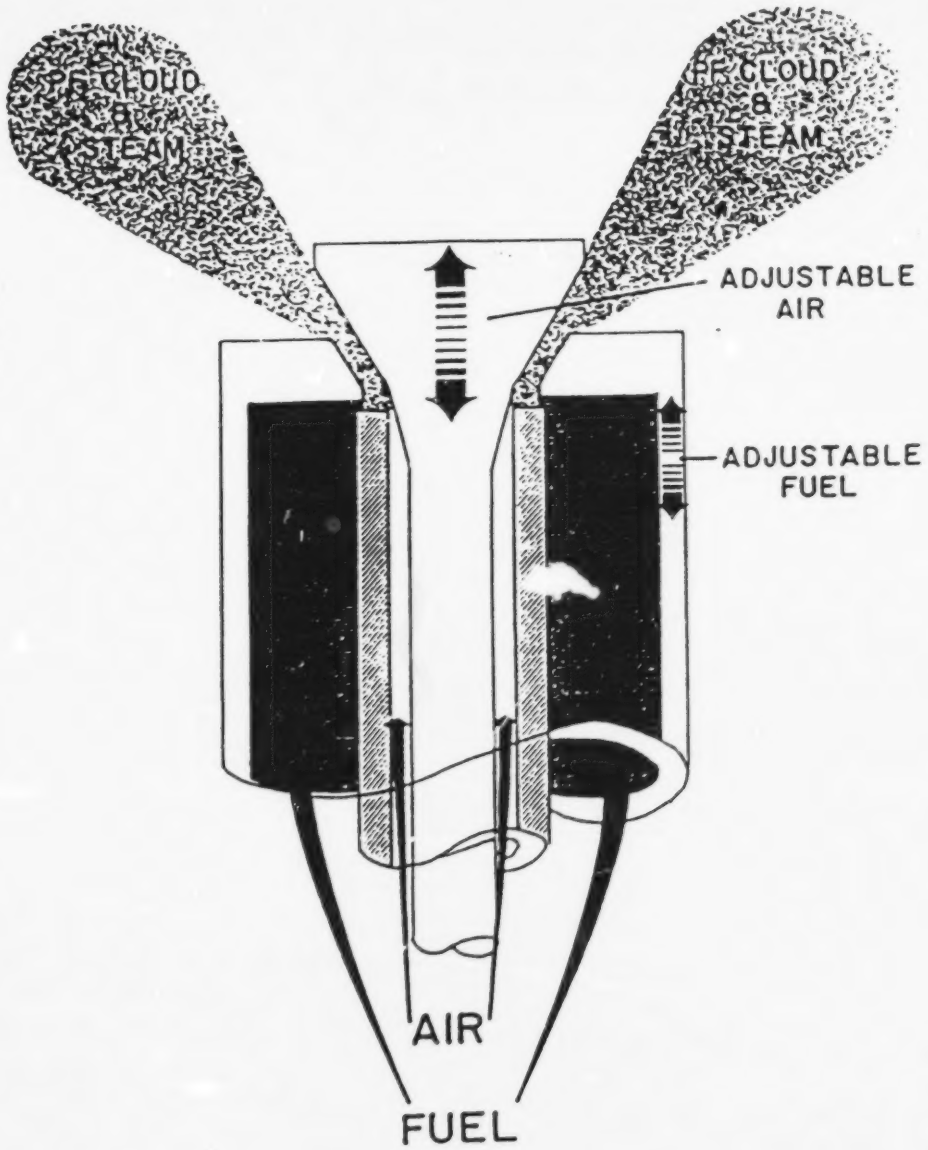
Division of Chemistry

National Research Council

Ottawa K1A 0R9

NRCC

COAL-WATER BURNER TIP SCHEMATIC



OCTOBER 16, 1984 TESTES IN RELATION TO N.R.C. BURN TRIAL ON #1 UNIT

11:30 A.M.

#1 and #2 guns on bunker trying #3 (a Forney gun) on C.W.M., we continue to have problems in relation to #3 burner.

12:45 P.M.

Tried N.R.C. gun, fuel would not atomize properly, large droplets falling into the ash-pit.

Removed gun, enlarged aperture, some fire but large unburnt particles floating in the furnace.

Moved gun into the furnace, unburned fuel was building up on the outer throat.

13:45

Removed Forney gun, fire was poor all day, trying to conserve fuel.

N.R.C. gun problem appears to be insufficent length (fuel spraying inside the burner gun tube) adjusted aperture and will position gun further into the furnace.

13:50

T.V. monitor proved the improper position of N.R.C. gun, made proper adjustments into the furnace.

13:55

Ceramic tip shows no cracking at this time.

14:05

N.R.C. gun lit-off poor flame at 70 psig and 100 psig C.W.M., pressure.
Decreased aperture.
Lowered C.W.M., to 80 psig.
Primary wide open.
Some unburned fuel at 4-6 o'clock.
No swirl due to primary damper wide open.

14:15

Good fire on N.R.C., gun with ignitor in place and primary open, will burn fuel off throats then optimize.

14:30

Primary closed, fire a little darker and some swirl.

14:35

Removed ignitor, small fire and dark, increased C.W.M., by 10 psig, started to crack primary fire-out.

Increased aperture, pilot removed, primary almost closed, fire small and dark.

14:55

Increased fuel to 130 psig, fuel impinging on the throat.

15:15

Increasing aperture to get more flame, still poor swirl, 100 psig, atomizing air at all times.

There is a build-up of fuel on the throat fuel reduced to 80 psig, will move burner assembly in 1".

15:35

Assembly in 1", no swirl, unburned fuel still accumulating on the throat,

15:45

Removed gun to burn fuel from the throat.

16:25

Meeting held in my office decided to go with 80 psig atomizing air and 50 psig C.W.M., primary damper to be open 1½ notch, secondary full open.

Tried gun with above settings, poor swirl ignitor still in place, unburned carbon in the ash-pit.

17:00

Air side may be plugged, no air flow showing on roto meter, went to 120 psig, air 50 psig, C.W.M., then to psig C.W.M., atomizing air flow decreased as the C.W.M., pressure increased.

NOTE: Is fuel pressure restricting the atomizing air flow?

17:15

Gun removed to check for pluggage, none found, ceramic cracked.

17:35

Gun in 120 psig air, 50 psig C.W.M., primary open, secondary closed, aperture opened, air flow showing 100 C.F.M, poor fire.

Decided to shut down and try again tomorrow.

Fuel Sample Analysis:-

985 cps at 20 Degrees C.

1.14 Density

31.24% Moisture.

N.R.C. TIP TEST "TIP A" KEITH KEOUGHAN OCTOBER 16, 1984

Coal water fuel in storage bunker at start of test outage 17' 7" innage 19' 9" 14,400 gal 86.4 short tons.

8:30 C.W. fuel burner front sample
Viscosity 985 cps @ 20 degrees C. density 1.14 moisture 31.24%.

10:40 No. 1 unit on line mininum load with bunker "C" oil

11:15 No. 3 burner lit off on c.w. fuel with original gun and tip for comparison purposes. Tried removing pilot. Flame unstable without pilot. Pilot back in service.

11:35 Gun purged (No. 3) back in service. Tip was checked and it was okay. Primary damper closed in now only one notch open. C.W. fuel pressure raised to 120 psig.

11:52 No. 3 gun - no pilot - swirl & fire stable - centre of flame quite dark. No. 3 burner historically has had dark centre most of the time.

12:56 N.R.C gun "A" connected to No. 4 burner and lit off. Fuel does not seem to be atomizing properly. Adjusting fuel pressures from 100 psig to 50 psig. No change. Adjusting atomizing air pressures from 120 psig down. No change.

11:20 C.W. fuel burner front sample
Viscosity 960 cps @ 21 degrees C. density 1.13 moisture 30.98%.

13:00 N.R.C gun purged - removing gun to check tip.
Increasing tip opening now at 30 thousand.
Load 7 MW vacuum 1.3" Hg aux steam off no 1 boiler.
No. 1 & 2 burner on bunker "C" oil.
No. 3 & 4 burners on C.W. fuel No. 4 N.R.C gun.
Total air flow 110,0000 lb/hr.
Steam flow 97,000 lb/hr.
Feedwater flow 92,000 lb/hr.
Windbox pressure 1.9" to 2.2" wg.
Drum pressure 590 psig.
Main steam pressure 575 psig.
Furnace draft - .09" wg.

13:10 N.R.C gun back in service on C.W. fuel with pilot.

NOTE: Moved gun tip one (1) inch into boiler past end of burner gun tube.
Adjusting fuel and atom. air pressures - flame very small - does not seem to be getting proper atomization. A lot of big pieces coming from gun. Fire not filling secondary throat. A lot of big globs of fuel spraying into furnace bouncing off secondary throat.

13:21 Secondary throat slagged over with unburnt fuel. N.R.C gun removed from service. Pilot left in to burn unburnt fuel off throat.

13:40 No. 3 gun removed from service.
No. 2 burner slagging on bunker "C" oil. Found primary damper No. 2 burner had vibrated closed. Operator error. Lock nut on damper not used when damper was initially opened.

13:50 N.R.C gun tip not past end of burner tube. Setting gun so tip will be 1½" to 2" past the end of the burner tube.

14:08 Trying N.R.C gun again in this position.

NOTE: Running primary air damper almost full open. It will not be possible to get swirl in the secondary throat with the primary damper open this far.

14:12 Burning unburnt fuel (slag) off secondary throat with N.R.C gun & pilot.

NOTE: Fire looks more like oil fire than c.w. fuel fire which would result with the primary damper almost fully open.
No. 3 burner N.R.C gun
Coal water fuel 55 psig
Atom. Air 100 psig
C.W. fuel header temperature 72 degrees F.

14:25 Coal water fuel burner front sample
Viscosity 960 cps @ 21 degrees C
Density 1.13
Moisture 31.05%.

14:36 Lost fire N.R.C gun when pilot removed C.W. fuel
70 - 80 psig
Atom. Air 100 psig
Primary damper 3/4 notch open pilot out very small

Partial swirl in secondary throat. Tried opening the primary damper - lost fire.

14:40 No. 3 N.R.C gun in service with pilot. Primary damper open 1 notch - out

14:45 Secondary throat very dark - opening primary.

14:46 N.R.C gun went out - trying all adjustments on No. 3 gun.

15:30 Moving No. 3 gun, gun tube & swirler 1" further into primary throat. Adjusting air-fuel damper positions. Quite a lot of unburnt fuel build-up on secondary throat. N.R.C gun removed from service using pilot to burn unburned fuel off throat.

15:45 Meeting D. MacDonald's office to review actions taken.

NOTE: Tried: Nozzel tip in maximum - gun to end of burner tube, moved swirler in 1" @ 15:30.
Fuel spray angle varies with atom. air and C.W. fuel
Will try: Increasing opening of tip to spray plate & try reduced atom. air & C.W. fuel pressures.
i.e., 50 psig C.W. fuel 80 psig atom. air.
primary damper 1¼ to 1½ notches open.
Secondary damper full open.
Try pilot out when flame looks stable.

16:25 Getting N.R.C gun ready for further tests.

16:28 N.R.C gun lit off with pilot. With pilot in service flame heavy and bright pilot side of burner. No swirl in secondary throat empty on side with no pilot.

16:37 C.W. fuel pressure up to psig - flame more like a burner "C" oil flame. Good and bright with pilot some fire flys.

16:41 Increasing atom. air to 100 psig to 110 psig. Unburnt fuel building up on secondary throat.

16:50 Gun & pilot out blowing fuel off throat with damper operation.

17:10 N.R.C gun removed from boiler to check tip & gun. When checjed it was clean fuel & air sides, some cracks on ceramic tip.

17:31 N.R.C gun in with pilot 50 psig C.W. fuel 80 psig atom. air trying primary full open sec. damper almost closed. Lit off.

17:33 Weird looking fire - unburnt fuel on sec. throat sec. damper opened more, Gun out, unit off line at 17:45 hours.

October 17, 1984

NOTE: N.R.C tip has 45 tho. space between tip & sprayer plate.

8:05 No. 1 Unit on line on Bunker "C" oil minimum load. Work Order: Cut 5½"(Inches) off burner tube on No.4 burner No. 1 boiler. NR.C tip B gun is shorter than A gun.

10:05 No. 4 gun in on C.W. fuel, atom. air 100 psig C.W. fuel 50 psig. Fire bright in primary throat with pilot - no flame in secondary throat.
Secondary damper full open.
Pri. damper 3¼ notches open.
Windbox pressure 1.1" wg.

10:10 Some unburnt fuel build-up on bottom of sec. throat.

10:12 Opened primary damper to 10 notches open. Secondary damper full open.

10:13 No gun in No. 3 burner. No. 3 burner sec. damper closed to get more secondary air to No. 4 burner.

10:14 Pie shaped piece of unburnt fuel from gun tip to sec. throat. On sec. throat between 4 & 7 o'clock.

10:15 N.R.C gun removed from service and purged. Burning unburnt fuel off throats with pilot.

10:20 N.R.C gun removed to check tip. Closing in gap off N.R.C tip. Using smaller shim. N.R.C tip how has 35 tho. space between tip and sprayer plate. Using 17 tho. shim.

10:30 Using dampers to try and burn. Knock unburnt fuel off throat. Increased windbox press. to 1.4" wg. Most of unburnt fuel off hust two (2) small pieces on secondary throat.

10:45 Conducting spray pattern tests using purge water on gun. Adjusting dampers to obtain best combination impingement on throat. Best spray pattern obtained with secondary damper full open and primary damper just about closed off (½ notch open).

11:11 No. 4 gun N.R.C in on C.W. fuel with pilot.
Atom. air 80 psig, C.W. fuel 40 psig.
Pri. damper ½ notch open. sec. damper full open.
Good swirl nice bright fire, pilot out. Not enough heat in throats causing the slow loss of swirl.
Increased windbox press. to 2.2" wg. C.W. fuel pressure to 60 psig. Pilot removed. Flame dark and orangey.
Swirl in sec. throat fiarly stable. Burnt for 5 to 6 minutes loosing stability. Gun out and purged. Not enough heat in throats to maintain stable fire.

11:40 Total air flow reduced to 77,000 lb/hr. from 88,000 lb/hr. Steam flow 64,000 lb/hr. Windbox down to 1.3" wg.

11:44 No. 4 burner (N.R.C) in on C.W. fuel with pilot.

11:55 Pilot out lost stability - pilot back in service.
Increased C.W. fuel press to 60 psig atom. air press. to 90 psig.

11:56 Pilot out swirl stable - centre a bit dark. Flame quite dark & organey.
Tried higher C.W. fuel pressure - flame got darker and lost stability.

12:02 Adjusting A. Air & fuel pressures - pilot out C.W. fuel 90 psig atom air 110 psig. Total air flow increased from 77,000 lb/hr to 85,000 lb/hr. Windbox press 1.5" wg.

12:15 Total air flow to 92,000 lb/hr windbox up to 2" wg.
Flame still quite dark and orange.
Lost fire pilot back in service.

12:27 Atom. Air 105 psig, C.W. fuel 80 psig. Increasing total air flow to 100,000 lb/hr to get more sec. air at burner flame. Windbox press 2.6" wg.

12:30 Pilot out, good stable swirl - fire brighter.

12:36	Flame getting worse - loosing stability - pilot back in service, only stable 4-6 minutes after pilot removed. At best conditions swirl does not fill secondary throat, as much as reg. C.W. fuel guns do.
12:38	C.W. fuel bunker outage 18' 4" innage 19' 0".
12:45	Replaceing light oil hose on No. 4 burner pilot.
12:50	Moving burner tube and swirler one (1) inch out of boiler back to original position. Moved it in one inch yesterday.
13:01	Pilot removed from No. 4 burner. Fire much brighter, swirl stable. 90 psig C.W. fuel, 106 psig atom. air windbox pressure 2.5 to 2.6" wg. Secondary air damper fully open. Primary closed off. Air flow 1000,000 lb/hr. Steam flow 64,000 lb/hr load 3 mw + 1.5 aux. steam No. 1 & 2 burners, oil No. 4 on C.W. fuel.
13:11	C.W. fuel bunker outage 18'5" innage 18'11".
13:41	C.W. fuel bunker outage 18'6" innage 18'10"
13:53	Primary damper opened 1/4 notch - loosing swirl stability. Swirl not full of throat.
13:55	Removing N.R.C gun to increase tip opening to 40 tho. between tip and sprayer plate.
14:08	NRC gun in on C.W. fuel and pilot.
14:22	Atom air 90 psig C.W.F to psig pilot out lost flame.
14:30	C.W. fuel pressure gauge No. 4 Burner not indicating pointer off gauge - will record header pressure.
14:32	Whole assembly moved out of boiler 1" fuel seems to be hitting throats - moving it back into boiler 1/2".
14:35	Large build-up of unburnt fuel on throats.

14:40	Pilot out - back in poor stability.
14:43	Moving assembly into boiler 1/2" to original position.
14:45	Trying to blow fuel off throats by cycling dampers.
14:50	Increasing press. atom. air 106 psig C.W.F header 85 psig.
15:03	Changing to atom. steam from atom. air. (15:04).
15:16	C.W. fuel off. Bunker "C" oil on to gun 50 psig atom. steam (?) Bunker "C" oil press primary damper now fully open - good bright fire. Pilot still in service.
15:20	Pilot out - increasing gun pressures - good bright clean fires.
15:30	Total air flow exceptionally high for load on unit. Air high to clean C.W. fuel fire on N.R.C gun. Dropping total air flow to normal air flow from 112,000 lb/hr to 76,000 lb/hr.
15:55	Steam supply connected to heating jacket on N.R.C gun.
16:00	Supply connected.
16:02	Purging N.R.C gun - steam purged both sides - light oil. Pilot in service.
16:04	Purging pilot.
16:05	Steam off. Atom. air on to both sides of gun to cool gun.
16:07	Gun wetted down both sides with water - back on air both sides. Bringing total air flow back up on boiler.

16:10 No. 4 pilot in service.

16:11 C.W. fuel on to N.R.C gun No. 4 burner, fuel temp. in gun 21.5 degrees C.

16:15 Pilot out, loosing flame - pilot back in service - opening steam supply on jacket of N.R.C gun.

16:16 Jacket temp. 35 degrees C.

16:19 Jacket temp. 30 degrees C pilot out - flame some better.

16:23 Fire looking quite shabby.

16:24 Pilot back in to stabilize flame.

16:25 Jacket temp. 36 degrees C.

16:27 C.W. fuel 60 psig changed from atom. air to atom steam

16:28 Pilot oil atom. air press throttled down. Swirl of burner quite dark top of throat (no pilot there).

16:29 Cycling dampers to knock fuel off throats.

16:31 Reducing total air flow windbox 3.2" to 2.5" wg.

16:34 Swirl brighter - flame filling throat more with pilot. In service at reduced pressures. 60 psig C.W fuel 86 psig atom steam.

16:36 Pilot out - lost flame - pilot back in service. Starting to get quite a lot of fire flys.

16:39 Removing N.R.C gun from service - purging gun. Tests completed for day - shutting unit down.

16:45 No. 1 unit off line.

NOTE: Fuel inventories checked at end of test, C.W. fuel bunker outage 18' 8".

18:30 Bunker "C" oil inventory.

"A' Tank Outage	2' 4"
"B" Tank Outage	2' 2"
"C" Tank Outage	39' 11"
Light Oil Innage	6' 11½"

Burner Front Samples	08:20	13:30
Viscosity	930 cps @ 21° C.	91[illegible] cps @ 21° C.
Density	1.13	1.13
Moisture	31.04%	31.47%

APPENDIX 3

(PURCHASE ORDERS)

BUSINESS FORMS MONCTON 5107930

PURCHASE ORDER COMMANDE

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

MATERIAL RECEIVED REPORT NUMBER

RECEIVED FROM SHOW ONLY IF DIFFERENT FROM SUPPLIER UNDER "ORDERED FROM" BELOW

SUPPLIER NAME

ADDRESS

DATE: 84-11-21

PURCHASE ORDER NO / N° DE COMMANDE: 060-1888

VENDOR NUMBER: 022139

SHIP TO/DESTINATAIRE:
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
LA COMMISSION D'ÉNERGIE ÉLECTRIQUE DU NOUVEAU-BRUNSWICK

TO/A

Center for Energy Studies
Tech.University of Nova Scotia
P. O. Box 1000
1360 Barrington Street
Halifax, Nova Scotia B3J 2X4
Attention: Mr. G. Trivett

515 King Street
Fredericton, N. B.
E3B 4X1

ATT Dave Rankin FOR / POUR

F.O.B. POINT - POINT F.A.B	DELIVERY - LIVRAISON	SHIP VIA - EXPÉDIER PAR	F.S.T. - T.F.V.	TERMS - ÉCHÉANCE
Delivered to site	See Below		☐ INCLUDED COMPRISE ☑ NOT INCLUDED NON COMPRISE ANY EXEMPTIONS ARE NOTED PER CODES BELOW TOUTES LES EXEMPTIONS SONT INDIQUÉES PAR LES CODES	See Below

ITEM ARTICLE	DESCRIPTION	OUR STOCK NO	UNIT OF ISSUE	QUANTITY QUANTITÉ	PRICE PRIX
	C/F Burner Demonstration MATERIAL LIST NUMBER: 9999-001A Rental 1 Lezzon Burner				
	To supply for a demonstration burn test in Chatham.				
1	Demonstration of one complete Lezzon Nozzle Burner assembly complete, for installation in one burner of the Chatham No. 1 unit, including skid mounted auxiliary of variable speed pump, massflow meter, piping, valves, gauges, etc. delivered to Chatham and returned.				
2	Labour as necessary including, but not limited to G.S. Trivett, A. Todd, S. Carr, and W.Sloan to assemble, prepare and deliver the burner and auxiliary- take such measurements as are necessary and prepare the evaluation report- including all necessary travel and living expenses.				

...2

☐ EXEMPT MATERIAL | ADJUSTMENT REQUEST NO | DATE | QUANTITY TOTAL | PRICE AMOUNT

NO. OF PACKAGES | RECEIVED BY | UNIT CODE EXPLANATION

☐ PARTIAL SHIPMENT ☐ COMPLETE SHIPMENT ☐ MAIL ☐ EXPRESS ☐ FREIGHT ☐ OTHER

MATERIAL REC'D LOCATION	SOURCE CODE	MATERIAL REC'D & COUNT BY	DATE

DELIVERING CARRIER

P	SYS	SUB	S.W.	COM	AMOUNT
	010	2	22	2	

ITEMS	ACCOUNTING DISTRIBUTION MAIN	SUB	COST CENTER	SOURCE CENTER	COST CONTROL ASSET/COMPT	TRACKING	AMOUNT
	667	920	44000	44000			

ORDERED IN STORES

UNIT	ABBR CODE	UNIT	ABBR CODE
CENTIMETRE	CM 01	JAR	JR 44
GRAM	GR 02	OUNCE	OZ 46
KILOGRAM	KG 03	PACKAGE	PK 49
LITRE	L 04	PAD	PD 52
METRE	M 05	PAIR	PR 55
MILLIMETRE	MM 06	PIECE	PC 58
MILLILITRE	ML 07	PINT	PT 61
SQUARE METRE	M² 08	POUND	LB 64
BAG	BG 10	QUART	QT 67
BALL	BL 13	ROLL	RL 70
BOARD FOOT	BF 16	SACK	SK 73
BOOK	BK 19	SET	ST 76
BOTTLE	BT 22	SHEET	SH 79
BOX	BX 25	SPOOL	SP 82
CAN	CN 28	98 FOOT	9F 85
DOZEN	DZ 31	98 YARD	9Y 85
EACH	EA 34	STICK	ST 88
FOOT	FT 37	TUBE	TU 91
GALLON	GL 40	THOUSAND	M 94
GROSS	GR 43	YARD	YD 97
HUNDRED	C 46		

MOORE SPEEDSET

ORDER CONTINUATION **CONTINUATION DE COMMANDE**

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
LA COMMISSION D'ÉNERGIE ÉLECTRIQUE DU NOUVEAU-BRUNSWICK

527 RUE KING STREET, FREDERICTON, N.B., CANADA, E3B 4X1
TÉLÉPHONE (506)453-4444 TELEX 014-46194

DATE
84-11-21

PURCHASE ORDER NO. / N° DE COMMANDE
060-1888

SHIPPING ADDRESS TERMS AND CONDITIONS ARE AS NOTED ON PAGE ONE
L'ADRESSE D'EXPÉDITION ET LES MODALITÉS SONT MENTIONNÉES À LA PREMIÈRE PAGE

ORDER CHANGE NO. / N° DE LA MODIFICATION DE COMM.

TO/À: Center for Energy Studies

PAGE NUMBER / N° DE PAGE
2 of/de 2

NO.	DESCRIPTION	OUR STOCK NO	UNIT PRICE	QUANTITY	U/M	AMOUNT
	Delivery: Schedule demonstration of burner at Chatham shall be complete by December 1, 1984. Report completed and (6) six copies delivered to NB Power by January 25, 1985.					
	Terms of Payment: 75% may be invoiced upon completion of the test burn in Chatham. 25% may be invoiced upon receipt of 6 copies of the final report.					
	Payment will be made within 30 days of receipt of an acceptable invoice by NB Power.					
	Reference: G.S.Trivett telex to D.M.Rankin 84-7-26 (quote) D.M.Rankin telex to G.S.Trivett 84-7-30 (reply) G.S.Trivett telex to D.M.Rankin 84-8-02 (quote)					

FORM NO. 9
REV. 23/10/74

NEW BRUNSWICK ELECTRIC POWER COMMISSION

PROJECT: CWF Burner Demonstration DATE: October 1984

MATERIAL LIST NUMBER: 9999-001A SHEET: 1 OF 2

Rental 1 Lezzon Burner

REF. DWG.:

ACCT. DIST'N.: 667-920-44000 ORDER NO.: 060-1888

DRAWN: D. Rankin CHECKED: APPROVED:

ITEM NO.	NO. REQ'D.	DESCRIPTION	PRICE
		Please place an order with:	
		Center For Energy Studies	
		Technical University of Nova Scotia	
		P.O. Box 1000	
		1360 Barrington Street	
		Halifax, Nova Scotia B3J 2X4	
		Attention: Mr. G. Trivett	
		To supply for a demonstration burn test in Chatham.	
1	1	Rental of one complete Lezzon Nozzle Burner assembly	
		complete, for installation in one burner of the	
		Chatham No. 1 unit. Including skid mounted auxiliary	
		of variable speed pump, massflow meter, piping, valves,	
		gauges, etc. delivered to Chatham and returned.	$10,608.00
2		Labour from the Center For Energy Studies as necessary	
		including, but not limited to - G.S. Trivett, A. Todd,	
		S. Carr and W. Sloan to assemble, prepare and deliver	
		the burner and auxiliary - take such measurements as	
		are necessary and prepare the evaluation report -	
		including all necessary travel and living expenses.	$ 9,259.26

FORM NO. 9
REV. 23/10/74

NEW BRUNSWICK ELECTRIC POWER COMMISSION

PROJECT: CWF Burner Demonstration DATE: October 1984

MATERIAL LIST NUMBER: 9999-001A SHEET: 2 OF 2

Rental 1 Lezzon Burner

REF. DWG.:

ACCT. DIST'N.: 667-920-44000 ORDER NO.: 060-1888

DRAWN: D. Rankin CHECKED: APPROVED:

ITEM NO.	NO. REQ'D.	DESCRIPTION	PRICE
		Schedule demonstration of burner at Chatham shall be	
		complete by December 1, 1984. Report completed and	
		(6) six copies delivered to N.B. Power by January 25,	
		1985.	
		Terms of payment - 75% may be invoiced upon completion	
		of the test burn in Chatham. 25% may be invoiced	
		upon receipt of 6 copies of the final report.	
		Payment will be made within 30 days of receipt of an	
		acceptable invoice by N.B. Power.	
		Total Price $19,867.26	
		Prov. Taxes Ø	
		Federal Taxes Ø	
		Transportation Included	

APPENDIX 4

DETAILED ACCOUNT SUMMARY

CORP- WORK IN PROGRESS
PERIOD COVERED 84/10/01 TO 85/01/31 WIP CAPITAL JOB 66744000
WORK ORDER AMOUNT 0

SUB	DESCRIPTION	TX CD	TX DATE	SOURCE	DESCRIPTION	HRS QTY	UNIT PRICE	ORIGINAL AMOUNT	OVERHEAD BURDEN	JOB COST	CONVR
909		411	GL100	CHATHAM GENERATION NGA006		0.0	.00	29,769.09- 28,958.28-	.00	29,769.09- 28,958.28-	
TX TOT								28,958.28-		28,958.28-	
SUB TOT		411	GL100	TSER FUEL CHGS RE DEMA003T		0.0	.00	19,717.79 19,717.79	.00	19,717.79 19,717.79	
[redacted]		41	410	05132	61640	1.0	239.52	239.52	29.82	269.34	
		41	410	05129	61600	1.0	265.14	265.14	33.01	298.15	
		41	410	05128	61120	1.0	89.04	89.04	11.08	100.12	
		41	410	05135	61660	1.0	40.02	40.02	4.98	45.00	
		41	410	05137	62212	1.0	312.72	312.72	38.94	351.66	
		41	410	05130	61610	1.0	2,476.71	2,476.71	308.35	2,785.06	
		41	412	04442	61650	1.0	160.44	160.44	19.98	180.42	
		41	412	04441	61640	1.0	50.40	50.40	6.28	56.68	
		43	410	05134	61650	1.0	53.48	53.48	.62	54.10	
		43	410	05138	62212	1.0	449.08	449.08	5.16	454.24	
		43	410	05136	61660	1.0	177.78	177.78	2.04	179.82	
		43	410	05133	61640	1.0	203.86	203.86	2.34	206.20	
		43	410	05131	61610	1.0	3,318.60	3,318.60	38.16	3,356.76	
[redacted]								7,836.79		8,337.55	
		61	412	609858	008RR453942009I	1.0	63.00	63.00	.00	63.00	
		61	411	331108	006003279420249	1.0	145.75	145.75	.00	145.75	
		61	411	331108	006003279420249	1.0	87.90	87.90	.00	87.90	
		61	411	000238	002897499420248	1.0	107.63	107.63	.00	107.63	
		61	411	592479	009016519420250	1.0	515.99	515.99	.00	515.99	
		61	412	420075	007117027300449	1.0	365.50	365.50	.00	365.50	
		61	501	282848	009135527305418	1.0	18.98	18.98	.00	18.98	
		61	501	145131	009137077305419	1.0	33.50	33.50	.00	33.50	
[redacted]								1,338.25		1,338.25	
[redacted] TOT								28,892.83		[redacted]	
[redacted]		411	GL100	TSER ENERGY CREDITS OA0153-		0.0	.00	2,826.45- 2,826.45-	.00	2,826.45- 2,826.45-	
SUB TOT								2,826.45-		[redacted]	
PEP TOT								67,334.91-		35,571.14-	
JOB TOT								67,334.91-		35,571.14-	